

Radiation Safety Precautions in the Treatment of Patients with Radioiodine (¹³¹I):

Best Practice Guidelines of the American Thyroid Association

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OVERVIEW

These guidelines are intended to assist physicians who treat patients with radioiodine (¹³¹I) with the goals of complying with federal regulations and minimizing radiation exposure to family members and the general public. The basis for the guidelines was a survey by the American Thyroid Association of those administering radioiodine and caring for these patients that revealed a wide variation in instructions given to patients who were to undergo ¹³¹I treatments. Our goal is to provide clear, uniform, practical recommendations that recognize the need for flexibility in individual circumstances.

BACKGROUND

In 1997 the Nuclear Regulatory Commission (NRC) changed the release criteria for patients treated with ¹³¹I from an "activity-based limit" to a "dose-based limit" which allows release of patients with higher levels of activity (10 CFR 35.75). For many, this was a welcome relief from a restrictive requirement that mandated a hospital stay in isolation for patients treated with 30 mCi or more of ¹³¹I. For others, however, it raised concerns of safety for those exposed to treated patients who in the past would have been hospitalized but now were released back into their home and community. The current federal regulations regarding the administration of radioiodine can be accessed at: www.nrc.gov or via the internet by searching 10CFR35.75. In brief, the regulations state that a patient who has been treated with ¹³¹I may not be released from the treating facility if the radiation dose to family members or caregivers is likely to be greater than 5 millisievert (5 mSv) (1 mSv = 0.1 rem, Roentgen equivalent in man). Radiation detection instruments usually give rem or Roentgen per hour. The limiting dose to small children, pregnant women and the general public is 1 mSv. The treating physician is required to provide the patient with written instructions regarding behavior modifications which will insure compliance with the Nuclear Regulatory Commission (NRC) regulations and, in addition, insure that the radiation dose to other individuals is as low as is reasonably achievable (ALARA). The regulations apply to all patients who are treated with ¹³¹I including those treated for thyroid cancer, hyperthyroidism and goiter.

The change in regulations by the NRC has been controversial. In 2005, a petition (petition for rulemaking docket No. PRM-35-18) (1) was submitted to the NRC requesting that the patient release rule (10 CFR 35.75) be reversed (Crane, P. G. Petition for Partial Revocation of the Patient Release Criteria Rule. http://ruleforum.llnl.gov/cgi-bin/library?source=*&library=crane_lib&file=*&st=petitions-a,1660. 2005.). The NRC allowed public comment in response to this petition. The ATA formulated a response based on input from its Clinical Affairs and Public Health Committees as well as its Board of Directors. During this process it became apparent that the safety precautions provided to patients after ¹³¹I therapy varied greatly among members of these committees. This led to the development of a survey of

current ¹³¹I safety precautions. This survey confirmed that there was discordance in the instructions provided to patients and that even within the same institution the patient might receive different instructions from their referring provider than they received from the Nuclear Medicine Department or Radiation Safety Officer. In addition to the survey questions, actual handouts of patient instructions were solicited from the survey respondents. These were analyzed and tallied revealing a range of instructions from those that were very restrictive to others that were relatively lax. Additionally, there were examples of discordances such as “use disposable utensils” vs. “do not use disposable utensils” provided in different sets of instructions.

The ATA assembled a multidisciplinary task force to formulate “Best Practice Recommendations” for ¹³¹I safety precautions. The ATA Board of Directors appointed representatives from the Nuclear Medicine field, Radiation Safety and Physics and Endocrinology. Liaisons from the Clinical Affairs and Public Health committees also assisted in the process. This task force reviewed instructions that were currently being provided to patients and assessed their validity and, in addition, evaluated precautions that were often overlooked. They assessed situations that presented real challenges to patients and their families and utilized existing data and standards to suggest ways to adapt these precautions for individual circumstances. The overall goal of these recommendations is to limit the exposure of family members and care givers as well as the public as defined above, without requiring unnecessarily onerous behaviors of little benefit. There are an increasing number of studies that assess actual measured radiation exposure to household members as opposed to calculated exposures. For the most part these studies are reassuring and support the use of appropriate and realistic instructions rather than overly conservative restrictions. However, these reassuring data were acquired in patients and their household who were following safety precautions. Even under these ideal circumstances, some household contacts were exposed to radiation that exceeded recommended amounts. This is especially critical for babies and children under the age of 10 years.

Previously many of these patients were hospitalized in isolation rooms, often with lead-shielding, designed to keep radiation to adjacent areas as low as possible. For most, the availability of rational guidelines that are protective of radiation exposure and can be followed as an outpatient is an attractive alternative. For those individuals or families for whom the safety precautions are too difficult, however, hospitalization may still be the best option.

BEST PRACTICE GUIDELINES

It is essential that radiation safety guidelines are reviewed with patients as the decision to treat with ¹³¹I is considered, not as a last minute handout. A questionnaire (Table 1) is provided to systematically evaluate the patient for the potential exposure risks and the suitable treatment setting. The required precautions will often influence the choice and timing of ¹³¹I therapy. Allowing for preparation by the patient and their household members and employer is only considerate and reduces the ultimate stress of such treatments. Due to constraints of travel, some patient may consider alternative lodging after treatment, and there are a number of considerations that can minimize exposure (Table 2).

Most of the radiation exposure from patients treated with ^{131}I arises from high-energy gamma rays (photons). Two important variables determine how much radiation exposure a person receives from a treated patient: distance and time. This type of radiation decreases with the square of the distance from the source. It can be minimized by spending as little time in close proximity to the treated individual as possible. The other potential radiation exposure is from ingestion of ^{131}I which has been excreted by the treated individual. When ^{131}I is ingested it is taken up by the thyroid gland. This is especially concerning for young children, whose thyroid glands are more sensitive to radiation. The majority of the excretion of radioiodine occurs via the urine, with smaller amounts present in saliva, sweat and other body fluids. Specific recommendations are provided to minimize the effects of both of these sources of radiation exposure (Table 3). A table which can be used to calculate the duration of this type of restriction for different administered amounts of ^{131}I and an example of precaution requirements for different thyroid conditions are included (Tables 4). This document includes also recommendations regarding personal hygiene for treated individuals, and an information card about their recent treatment that is intended for patients to carry (Table 5).

Pregnant women should never be treated with ^{131}I , and a pregnancy test must be performed in close proximity (usually within 72 hours) to treatment in all women who could potentially become pregnant from menarche to 2 years after menopause. Lactating women and those who have recently stopped breast feeding should not be treated with ^{131}I since the lactating breast concentrates a significant amount of iodine. This document includes a screening tool (Table 1) that allows physicians and treating facilities to determine which patients have special considerations and may require more extensive precautions.

Treating physicians are responsible for instructing patients in practices that comply with Nuclear Regulatory Commission regulations and thereby ensure radiation safety of the patient, the patient's family and caregivers, and the public at large. These guidelines are presented to aid this process and enhance the quality of care delivered to patients treated with ^{131}I for diseases of the thyroid gland. These recommendations are not meant to be a stand-alone instruction manual but should be accompanied by review, discussion, explanation and individualization. It is our hope that the referring provider and the administrating service will utilize these instructions to reduce confusion and uncertainty and in so doing increase the safety of those exposed to the ^{131}I treated patient and allow the current release criteria to continue.

BASIS FOR RADIATION SAFETY GUIDELINES-EVIDENCE IN THE LITERATURE

Dose Limits/Guidelines

- The United States Nuclear Regulatory Commission (NRC) regulations for the release of patients administered radioactive material, pursuant to 10 CFR 35.75, authorize patient release according to a dose-based limit, i.e., the dose to other individuals exposed to the patient. A licensee may release patients, regardless of administered activity, if it can be demonstrated that the total effective dose equivalent (TEDE) to another individual from exposure to a released patient is not likely to exceed 5 mSv and the TEDE to a member of the general public is not likely to exceed 1 mSv [1, 2].

- The International Commission on Radiological Protection (ICRP) does not specifically recommend dose constraints for friends and relations helping in the support and comfort of patients (as these exposures are defined as medical exposures by ICRP), however the ICRP does note that a value in the region of a few mSv per episode is likely to be reasonable [3]. The ICRP has recommended a dose constraint of 1 mSv/y (i.e., the public dose limit) for visitors who are not essential to patient care or comfort and for infants and young children who live with the patient [3].
- The National Council on Radiation Protection and Measurements (NCRP-155) bases release criteria for patients receiving therapeutic amounts of radiopharmaceuticals on the prevailing NCRP recommendations of 5 mSv annually for family members caring for or living with persons treated with therapeutic amounts of radiopharmaceuticals [4, 5]. It further recommends the public exposure limit of 1 mSv annually for pregnant women and children [6].
- The International Atomic Energy Agency (IAEA) [7, 8] recommends that the dose of any comforter or visitor shall be constrained so that it is unlikely that his or her dose will exceed 5 mSv during the period of a patient's diagnostic examination or treatment. The dose to children visiting patients who have received radioactive materials should be similarly constrained to less than 1 mSv.
- According to the National Research Council of the National Academies' study on the health risks from exposure to low levels of ionizing radiation, the lifetime attributable risk of cancer incidence following a dose of radiation is highest at younger ages and decreases with age [9]. Risks are significantly greater in children than older adults. The risk of thyroid cancer following exposures at ages 60 or older is less than 1% of the risk at ages 5 and younger.
- In a pooled analysis of seven studies of thyroid cancer after external exposure to radiation (including almost 60,000 irradiated individuals), the excess risk was greatest for those exposed before the age of 15 years. The risk of thyroid cancer declined notably with increasing age at exposure and effectively disappeared beyond an exposure of age of 20 years [10]. Therefore there is a rapid decline in risk to a relatively low level for young adults [11].

External Direct Dose

- NRC has evaluated that direct external exposure as the primary concern when considering release of patients who have received ^{131}I in therapeutic doses [12]. ICRP also notes that for medical personnel, relatives, and caregivers, the major source of radiation is from external exposure [3].
- The retained activity in the patient is a function of a number of factors including, but not limited to, the quantity and function of the thyroid gland including level of free T4 and TSH, the radiopharmaceutical, hydration, and renal function. For example, the cumulative external exposure from a patient who has received a given activity of ^{131}I will vary by a factor of 2 or 3 depending on whether the patient is euthyroid, thyrotoxic, or being treated for thyroid cancer. [3]
- NRC guidance document provides "default" patient release values [12] based on extremely conservative assumptions that the activity in the patient can be represented as an unshielded

point source and that removal of the activity from the patient is only due to physical decay of the radionuclide involved. The use of “default” assumptions results in a limit of 33 mCi (1221 MBq) administered activity for release of patients. Note that this value is conservative because it does not consider the distributed nature of radiopharmaceutical agents [13] (i.e., the use of an un-attenuated point-source model will overestimate doses to nearby people [3]), and does not take into account the significant biological elimination of such agents.

- NRC guidance document also provides a “patient-specific” dose equation that can be used to estimate the likely external exposure to total decay in mSv (mrem) to an individual from a released patient receiving oral ^{131}I for thyroid cancer or hyperthyroidism [12]. This modified method results in upper bound of 57 mCi or 221 mCi for releasing hyperthyroidism or thyroid cancer patients, respectively.
- The use of NRC “patient-specific” guidance equations also typically results in a conservative estimate with regard to patient release precautions [14] because the NRC utilizes an exposure rate constant which is an unshielded point source value and uses an 8 h non-void period with an associated 0.75 occupancy factor. Once again, the NRC guidance values do not take into account the distributed nature of radiopharmaceutical agents and they utilize a conservative assumption on whole-body retention of radioiodine (i.e., assumed activity excretion time delay). A recent international controlled study of iodine biokinetics in radioiodine therapy of thyroid cancer indicated that the whole body retention of radioiodine was generally described by a biexponential activity-time curve, with no significant excretion time delay [15]. In fact, approximately 50% of the administered activity is excreted from the body during NRC’s presumed non-void period in the case of a thyroid cancer patient [14].
- Dosimeter measurements obtained in 65 household members of 30 patients who received outpatient ^{131}I therapy for thyroid cancer indicated that the measured radiation dose was on average a factor of 10 times lower than the radiation dose predicted by the NRC guidance equations [16].
- Barrington et al. [17] reported that in a study of family member doses median adult doses were about 50 mrem and median child doses were less than 50 mrem with 97% (30/31) of comforters and caregivers and 89% (70/79) of children received less than 300 mrem and 100 mrem respectively. As such, the precautions for reducing external dose to individuals that have been calculated based on these guidance equations are conservative and restrictive for patients.
- Monsieurs et al. [18] reported that a median dose of 28.1 mrem (281 μSv) received by relatives of thyroid carcinoma patients and a median dose of 80.2 mrem (802 μSv) received by relatives of thyrotoxicosis patients. Lower doses are seen from the thyroid carcinoma patients because of the lower retention (thyroid remnant) and the more rapid washout of the ^{131}I activity from the body of thyroid carcinoma patients in spite of the typically higher activity administered.
- According to Thomson et al. [19, 20], the highest doses to relatives occurred during the night, with a median of 1278 μSv (s.d. 4072 μSv), while only a median dose of 240 μSv (+/- 560 μSv) occurred during the day. Monsieurs et al. [18] measured a bedside table dose of 1058 μSv and others have calculated that 92% of the total dose to a relative would occur during the night if the partner did not sleep separately from the patient [21].
- In a UK study of hyperthyroid patients with less than 800 MBq (21.6 mCi) of activity, the travel dose rate during their journey home averaged 49 $\mu\text{Sv/h}$ (range 4-152 $\mu\text{Sv/h}$) and some authors

have indicated that time restrictions for private transportation are not required for hyperthyroid treatment patients, and only occasionally for public transportation [3].

- ICRP compares a number of suggested travel time restrictions for therapy patients with travel times ranging from 0.5h to 9 h for public travel/day and 2h to 24h for private travel/day in order to limit exposure to those who come in contact with ^{131}I patients to 1 mSv/y [3]. Values are highly dependent upon administered activity.
- Mountford [22] has estimated close contact doses to young infants from surface dose rates on radioactive adults and has determined a close contact dose rate at 0.1 m of between 5.7 and 8.9 $\mu\text{Sv}/\text{MBq}$ of ^{131}I .
- Three methods have been evaluated in the literature that provide for more realistic assumptions when determining patient release activities and instructions based on external dose to individuals:
 - The Society of Nuclear Medicine (SNM) and the American College of Nuclear Physicians [23] suggest utilizing a reduced exposure rate constant ($1,700 \text{ mR cm}^2 \text{ mCi}^{-1} \text{ h}^{-1}$) instead of the point source value based on work by Carey [24]. In addition, they suggest the use of a 1 h void period with an occupancy factor of 0.25. Using these assumptions, the maximum activities for authorizing patient release are 80 mCi or 493 mCi for hyperthyroidism or thyroid cancer, respectively.
 - The National Council on Radiation Protection and Measurements (NCRP) [6] suggests that estimates be made based on actual measurements from the patients themselves and their methodology also includes the use of effective dose equivalent factors that further reduce the calculated dose to individuals by 20-46%. They provide a spreadsheet for estimating doses that is based on methodology developed by Zanzonico et al. [25].
 - Siegel et al. [14] also suggest a methodology that utilizes effective dose equivalent factors. Using their assumptions, the maximum activities for authorizing patient release are 103 mCi or 739 mCi for hyperthyroidism or thyroid cancer, respectively. However, the dose to the patient may constrain the mCi administered.

Internal Contamination Dose

- The ICRP [3] notes that radioactive iodine is excreted primarily in the urine with smaller amounts in saliva, sweat, and feces. A small amount is exhaled. These excretions could potentially expose relatives and caregivers. With the exception of contact with a patient's urine, a number of studies have shown that the risk of contamination with radioiodine is generally low but not negligible [3].
- In a study of a number of hyperthyroid patients who received 25 mCi of ^{131}I [26], the activity per ml was highest in saliva (approximately 10 uCi/ml), it was 20-fold lower in blood, and 1000-fold lower in sweat. Salivary activity decreased very rapidly down to 1% of administered activity within 3 d post therapy.
- In a study of radioiodine therapy for patients with thyroid cancer, 55% of administered activity was secreted in the first 24-h period following treatment, 22% in the second, and 6% in the third [27]. In fact, for hyperthyroidism and thyroid cancer patients, the proportion of administered activity (until total decay) that is discharged by urine and feces is 54% and 84-90%, respectively

[3]. Therefore, care must be taken to minimize contamination potential through contact with urine or feces.

- Peak excretion in urine occurs at 24-48 h [21, 28]. Patients who washed frequently had significantly lower amounts of removable contamination. Removable activity on the rim of toilets during the first 48 h post treatment was much greater for men (1500 Bq/cm²) than for women (20 Bq/cm²) [28].
- Mean salivary activity collected in the first 24h post treatment of hyperthyroid patients was measured at around 87 Bq/g/MBq administered, with maximal salivary activity occurring approximately 24 h post therapy [21]. For patients receiving 11 GBq of ¹³¹I, the 24h activity in saliva was 4 MBq/ml of saliva [28]. ICRP uses an average of approximately 100 Bq/ml saliva/MBq administered activity when evaluating potential for transfer of activity to others through saliva and notes that some authors recommend no mouth-to-mouth contact between the patient and their relatives for the first 48h post therapy [3].
- Secretion of activity in palm sweat was 45 kBq in 24h with poor correlation with administered activity or body size, thus, the risk from ¹³¹I contamination in sweat is small [3, 21].
- Lassmann et al. [29] demonstrated that in the case of radioiodine therapy, up to 0.1% of the administered ¹³¹I is released into the air of the therapy room, while Schomaecker et al. [30] indicated lower values and found that the amount of exhaled radioiodine ranged from 0.008%-0.03% of the administered activity.
- Two studies in the 1970s [31, 32] performed on the actual intakes of individuals exposed to patients administered ¹³¹I indicate that intakes were generally on the order of 1 millionth of the activity administered to the patient and that internal doses were far below external doses.
- A recent study of 53 adult and 92 children family members [33] has shown that small amounts of activity was found in the thyroid glands of only 32% of the adults and 28% of the children. Therefore, 83% of the adults and 92% of children had <27 nCi of ¹³¹I in their thyroids (effective doses of < 20 mrem), representing intakes that are <2x10⁻⁶ of the median activity administered to the patients. The maximum activity was 146 nCi in an adult (effective dose of 40 mrem) and 318.6 nCi in a child (effective dose of 170 mrem).
- In this same study [33], transfer of radioiodine via secretions occurred in 24 of the 47 families taking part in the study. However, 70% (102/145) of family members of patients who were given advice to minimize transfer of secretions had no measurable activity in their thyroid glands after treatment of a person in the household.
- When performing the regulatory analysis for 10 CFR 35.75, the NRC concluded that internal doses are likely to be much smaller than external doses and much smaller than the public dose limit, and therefore did not consider internal exposures in their analysis [34].
- The ICRP notes that contamination of adults is much less important than controlling external exposure (i.e., internal dose due to contamination is usually less than 10% of the external dose). However, they also note that it is important to avoid contamination of children and pregnant women due to the sensitivity of fetal and child thyroid glands to induction of thyroid cancer (note that the dose to the thyroid gland of an infant or young child after ingestion of ¹³¹I is about 4.3E-7 Gy/Bq [3]).
- The NCRP evaluated the potential for internal exposures from patient's secretions and excreta and concluded that "a contamination incident that could lead to a significant intake of

radioactive material is very unlikely” [5]. Similarly, Thomson and Harding [35] note that the radiation doses from ingestion due to contamination are small.

- When evaluating the potential for internal dose, the current NRC guidance [12] utilized an assumed fractional intake of 10^{-5} of the injected activity as the fraction that could potentially result in internal dose for individuals who may come in contact with a released patient who received ^{131}I . This value was chosen by the NRC in order to account for the most highly exposed individual and to add a degree of conservatism to the calculation.
- Siegel et al. [14] suggest the use of an intake fraction of 10^{-6} , based on the literature results and argues that since the internal dose is such a small fraction of the external dose, the total effective dose equivalent can be most effectively minimized by efforts to minimize the external dose component through adequate patient instructions.

Breastfeeding and Pregnancy Considerations

- The concentration of iodide in breast milk is up to 30 times higher than the free component in the plasma, because it is actively secreted into the breast and the peak excretion fraction per ml of breast milk has been estimated to be about $5\text{E-}4$ [36]. Breastfeeding should be ceased completely after a therapeutic dose of radioiodine in order to minimize significant dose to the infant. Continuation of breastfeeding is absolutely contraindicated after radioiodine therapy [36] because if this is not done, the infant may become permanently hypothyroid or be at high risk for subsequent thyroid cancer [3].
- The potential effective dose to an infant as a result of breastfeeding from a mother after a single ingestion of ^{131}I is significant and can run as high as $5.4\text{E-}8$ Sv/Bq [3].
- It may be beneficial for women to cease breastfeeding 2-6 weeks before receiving radioiodine therapy. The advantages are that the breasts will stop producing milk, dose to the breast tissue will be reduced, there is no danger of non-compliance, and contaminated brassieres and breast binders will not be an issue [3].
- Radioiodine can cross the placenta easily and the fetal thyroid begins to accumulate iodine at approximately 10 weeks gestational age [3]. Radioiodine therapy is therefore essentially contraindicated in patients who are known to be pregnant. If radioiodine treatment is necessary, it should be delayed until after delivery (note restriction on breastfeeding).
- ICRP notes that most female patients are advised not to become pregnant for at least 6 months after therapy with ^{131}I . This is not primarily based upon potential heritable radiation effects or radiation protection considerations per se, but is based upon the need to be sure that the hyperthyroidism or cancer is controlled, and another treatment with radioiodine will not be needed when the patient is pregnant [3].
- Other studies have recommended an interval of at least one year between the last administration of ^{131}I and conception, when the thyroid hormone levels have come under control [37]. A large scale study of 2,673 pregnancies that occurred after treatment for thyroid carcinoma concluded that “there is no evidence that exposure to radioiodine affects the outcomes of subsequent pregnancies and offspring” [38]. On the basis of that finding, the authors recommend postponing conception until the thyroid hormone status has been verified [38].

Radiation Detectors at Borders, Airports, etc.

- IAEA notes that when releasing patients with internal radionuclides who have measurable gamma emissions, unanticipated detection of such people at their place of employment, borders, airports, and other areas where there are radiation-detection systems is possible and likely [39].
- With current technology, it is possible to detect ^{131}I activity of approximately 0.01 MBq at 2 to 3 m [3].
- It is possible that ^{131}I patients could cause an alarm of such detection equipment for up to 95 days or more [40, 41].
- The NCRP suggests that patients should be made aware of the possibility of such alarms and should have a letter or card, containing appropriate information about the therapy, issued by the treating institution for display to authorities and should include a method of verifying this information with the treating facility [6].
- The Society of Nuclear Medicine (SNM) suggests that physicians can help their patients and security personnel by providing patients with a card or letter that includes at least the following information [42]: patient name, date of nuclear medicine procedure administered activity, and 24 h contact information.
- The U.S. NRC suggests that facilities that administer nuclear medicine procedures consider providing the patient with the licensee's business card and written information for law enforcement use, stating that the radiation received by the patient poses no danger to the public and that it is allowed by NRC medical use regulations [43].

Hydration of the Patient

- Internal dose to the patient's organs can be reduced by oral hydration of the patient and by encouraging frequent voiding [3]. An added benefit is the removal of the ^{131}I by urinary pathway and the associated reduction of external doses from the patient.

Trash Considerations

- Radioactive articles in the household trash of nuclear medicine patients have been reported to have been identified at solid waste landfills that have installed radiation monitors to prevent the entry of any detectable radioactivity [44]. Marcus and Aldrich [45] suggest that this potential might be reduced by using dishes that can be washed rather than paper products.
- The Pennsylvania Department of Environmental Protection [46] has determined that the likelihood that the short-lived radionuclides used in nuclear medicine will reach groundwater before the radioactivity has completely decayed is very slight and has suggested that all radioactive trash containing nuclear medicine radionuclides should be disposed of immediately since the disposal does not endanger the health or safety of the facility staff, the public, or the environment.
- While excreta from nuclear medicine patients are exempt from NRC regulations for disposal into the sanitary sewer system [2] there are no regulations for radioactive articles when they are

discarded into the patients' household trash and appear at landfills. According to the NRC [47], there is no documentation indicating that the dose rates from this household trash to the maximally exposed individuals have exceeded the dose limit in 10CFR35.75.

Length of Time for Precautions

Precaution times should be specifically evaluated for each patient, using one of the realistic dose-estimation models reviewed above. The precautions listed below are based on US NRC kinetics for hyperthyroidism or thyroid cancer [12], the Society for Nuclear Medicine gamma constant for ^{131}I [23], as well as the NCRP-155 [6] assumed occupancy factors, effective dose conversion factors, and patient-precaution algorithm methodologies. Note that these represent typical examples and the length of precaution times can be significantly less than or greater than those listed here, depending upon the methodology utilized to calculate effective doses.

DEDICATION

These guidelines are dedicated to the honor and memory of Dr. Jacob Robbins, a pioneer in the diagnosis and treatment of thyroid cancer, and a leader in investigating the adverse effects of radiation. Dr. Robbins very much wanted a unified set of safety precautions that would not unduly burden the patient or their families, but adequately protect family members as well as the public. He initiated the development of these guidelines, and we hope that they fulfill his vision. As more data is acquired linking radiation exposure levels to effects, these recommendations will need to be continually modified.

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Table 1-Eligibility and Screening Assessment

Absolute contraindications to ¹³¹I therapy (Pregnancy and Breastfeeding)

1. Confirm patient not pregnant by either
 - Negative pregnancy test within 72 hours prior to treatment or
 - Prior hysterectomy or at least 2 years postmenopausal (no menses for 2 years and age > 48)
2. Confirm patient not breast feeding or pumping for at least 3 to 6 weeks with no residual lactation
 - If concern about breast RAIU recommend ¹²³I scan
 - Breast feeding or pumping must not be resumed

Contraindications to Outpatient ¹³¹I therapy

1. The proposed iodine dose 250 mCi or more
2. The patient mentally and physically unable to comply with oral and written instructions.
3. The patient in not continent of urine or stool without the aid of assistive devices and the patient is unable to self-handle and clean devices or tubes that may contain body fluids (e.g., Foley catheter, feeding tube, tracheostomy, ostomy)?
4. See additional precaution limitations below

Information for Radiation Safety Precaution Planning

Travel

1. Travel to home on the day of treatment: Travel can be by private car, taxi, or car service if the patient can sit alone in a back seat and limits trip to 8 hours or if patient can drive alone(no time limit), as long as competent to drive and not impaired by hypothyroid status. Travel by bus, train, subway, ferry plane, or other public conveyance should be restricted and requires special precautions.

Private travel: _____

Public travel: _____ refer to radiation safety specialist for special precautions or consider for admission

2. Will duration of travel time with other passenger(s) be 8 hours or less?

Acceptable duration _____: seating distance: _____

Not acceptable _____ refer to radiation safety specialist/ consider for admission

Home

1. Discuss the patient's living arrangements (type of dwelling and relationship, age and sex of each household member).

a. Are any household members pregnant?

No _____ (standard precautions, see Hygiene list and tables)

Yes: Able to stay at least 9 feet away at most times

Yes _____ (standard precautions, see Hygiene list and tables)

No _____ see radiation specialist /consider for admission

b. Are any household members under the age of 10? (describe physical contact patient will have with the children)

NO _____ (standard precautions, see Hygiene list and tables)

Yes _____

Is the patient able to limit exposure or arrange alternate care?

Yes _____ (standard precautions, see Hygiene list and tables)

No _____ see radiation specialist/ consider for admission.

c. Is patient the caregiver for another person? (List persons, ages, and type of care the patient provides).

NO _____

Yes _____

Is the patient able to limit exposure or arrange alternate care or is the person cared for over age 60?

Yes _____ (standard precautions, see Hygiene list and tables)

No _____ see radiation specialist / consider for admission

3. What type of dwelling will patient live in for a number of days post-treatment? (single family home, multi-family home, apartment, dormitory room, other)

a. Will there be enough space to maintain at least 6 feet distance from others?

Yes _____ (standard precautions, see Hygiene list and tables)

No _____

Patient is able to stay elsewhere safely?

Yes _____ (standard precautions, see Hygiene list and tables)

No _____ refer to radiation specialist / consider for admission

b. Is patient able to sleep alone for a number of days post-treatment?

Yes _____ (standard precautions, see Hygiene list and tables)

No _____ refer to radiation specialist / consider for admission

c. Is there more than one bathroom to allow patient separate use of bathroom?

Yes _____ (standard precautions, see Hygiene list and tables)

No _____ See special precautions

Work / School

1. Discuss the patient's employment or school status, including type of employment, the physical work or school environment and contacts with coworkers or fellow students and commute to work/school.

2. Type of workplace/school?

a. Is there adequate space to maintain at least 6 feet distance for any prolonged exposures?

Yes _____ (standard precautions, see list and tables)

No _____ special instructions, delay return to work /school

b. When does patient return to work/school? _____

c. Are there pregnant women or minors in the workplace/school? (Yes, No, Don't know)

No _____ (standard precautions, see Hygiene list and tables)

Yes or do not know _____ special instructions or delay return to work/school

3 How will patient commute to work/school?

a. Will public transportation or carpooling be used?

No _____ (standard precautions, see Hygiene list and tables)

Yes _____ special instructions or delay return to work /school

SPECIAL SITUATIONS:

PREGNANCY: The new blood and urine pregnancy tests are usually positive at about one week gestation. Patients need to be advised in advance that pregnancy is a contraindication to ^{131}I therapy and should be warned to take precautions once treatment with ^{131}I is planned. Confirmation of negative pregnancy test is required but there will be some patients who later find out that they were indeed pregnant at the time of the ^{131}I dosing. The fetus will thus be exposed in a very early stage of pregnancy where the concern is whole body radiation exposure and not fetal thyroid exposure. This needs to be handled on a case by case basis and an analysis of the estimated radiation dose to the fetus should be performed by a qualified medical physicist and provided to the patient's obstetrician in an expedited fashion.

The recommendation to delay pregnancy in a female patient is based on the need for normalization of thyroid levels for a successful pregnancy and healthy infant and to ensure that additional treatment is not necessary. There is no data to confirm that fathering a child within 3 months causes congenital anomalies or increased fetal wastage, but we know that testicular damage ensues from several studies looking at serum FSH and Inhibin B levels from an estimated testicular irradiation of 0.085 rad/mCi/testes. It just seems prudent to wait for testicular damage to resolve.

BREASTFEEDING: Breast feeding needs to be discontinued for two reasons. The first and most critical reason is to prevent exposure of the infant's thyroid to the effects of ^{131}I . The second reason is to limit exposure of the patient's breast tissue to ^{131}I as the lactating breast contains sodium iodine symporters (NIS) and concentrates iodine. The duration of time needed to ensure that the breast tissue will no longer concentrate ^{131}I is not firmly established. If the woman is still intermittently breast feeding so that milk production is continuing or if there is

obvious milk still present despite cessation of nursing, then treatment should be delayed. If there is any question, an ^{123}I scan of the breast tissue can be performed. There is no report of untoward effects from breast irradiation of this type, but analysis is vitiated by the small number of cases and insufficient follow-up data; ALARA is the rule.

HYPERTHYROID vs. THYROID CANCER EXPOSURE ISSUES: Thyroid cancer patients usually have a larger initial dose with more radioiodine excreted through urine within the first 24 hours but thereafter their radioactivity levels drop off, especially when the patient is prepared for treatment with rhTSH and therefore not hypothyroid. Hyperthyroid patients, while usually treated with lower doses, have greater retention of radioactivity and greater quantities of circulating radioiodinated thyroid hormone because of the presence of intact thyroid tissue, with an effective half life of about 5 days for ^{131}I .

EXPOSURE TO PREGNANT WOMEN, INFANTS, CHILDREN UNDER 10 YEARS OLD: The risk is for future thyroid cancer or for the fetus, also hypothyroidism. The TEDE needs to be $<1\text{mSv}$. The greatest risk is from external exposure but care needs to be taken to avoid ingestion of contaminated substance as internalized ^{131}I will concentrate in the thyroid gland and impart potentially harmful thyroidal radiation.

If the patient is the primary care giver for young children or infants and cannot find alternative care then special care must be taken to minimize exposure to the children. Close contact should be limited to necessary care only for short time interval (i.e. a few minutes). Kissing should be avoided to prevent transmission of radioiodine in saliva.

Every attempt should be made to stay at least 9 feet away from a pregnant woman most of the time and no closer than 3 feet for brief periods of time only. If this cannot be accomplished then alternative lodging (as detailed below) should be considered.

CARETAKERS: Risk to those over age 60 is minimal and no special precautions need be made other than diminishing exposure to radioiodine in urine, stool and saliva.

CONTINENCE ISSUES: If there is mild urinary incontinence that is easily managed by incontinence pads and the patient agrees to the appropriate hygiene precautions and waste disposal then there are no additional issues. If however, the incontinence could is not easily handled by the patient then special precautions may be necessary. Recall that urine is the primary route of elimination of ^{131}I from the body and such urinary contamination must be avoided as much as possible.

DEVICE ISSUES: If the patient is capable of caring for and cleaning the devices on their own then no special considerations are needed, just appropriate hygiene measures. If the patient depends on family members or caretakers to provide such care then they must be adequately and specifically instructed on how to keep any radioiodine contamination to a minimum.

WORK/SCHOOL: Exposure of pregnant coworkers or children in the work place should be handled on a case by case basis to make sure than such exposures can be reasonably expected to be far < 1mSv.

TRAVEL: Transportation by private car is limited only if there are other passengers present. The distance from the patient to any other occupant should be kept to at least 3 feet with the time limit of travel dependent on the dose administered and other factors determined on a case by case basis and consultation of an ¹³¹I TEDE chart.

Mass transit type of public transportation (bus, train, subway, ferry) should be avoided if at all possible because of the difficulty of maintaining the desired 3 foot distance from other passengers. A trip by mass transit limited to a few*** (international 1 to 2 hours) hours is permissible if the patient can reasonably be expected to maintain such separation from any other individual passenger except for brief periods of time. The patient should change seats so to not expose any one person for long periods of time. The patient needs to stay away from obviously pregnant travelers or those with young children, especially infants.

Airplane trips are to be avoided as the time exposure is usually longer and there is not the option to remain far enough away from other passengers or to change seats so that no one person is exposed beyond the limits allowed for members of the public.

Table 2-Alternative Lodging (HOTELS/MOTELS): After Radioiodine Therapy- Radiation Safety Implications*

The patient who intends to use a rented room as their residence for the first 2-3 days after therapy can do so if the treating physician and/or the radiation health officer deems that it can be accomplished without exposing a member of the general public to excessive radiation by 1) limiting any close prolonged exposure to all individuals, and 2) preventing any significant excretory contamination. The patient needs to be instructed in how this can be accomplished and the following steps are suggested:

1. Register for your room and obtain the room key prior to receiving the therapy
2. Do not allow the room to be cleaned until after your departure
3. Arrange for sufficient food and drink for your stay that avoids close or prolonged individual contact
4. Pay meticulous attention to preventing urine or salivary contamination of the room by cleansing the toilet prior to departure and removing any disposable items
5. Shower immediately prior to sleeping and wear pajamas to reduce perspiration contamination of sheets

Using this approach, ^{131}I doses $> 1 \text{ GBq}$ can be readily administered to patients using alternative lodging post-therapy with good compliance with the ALARA (as low as reasonably achievable) radiation exposure concept.

*In April 1997, the United States Nuclear Regulatory Commission (NRC) issued 10 CFR 35.75, a regulation that changed the manner in which patients treated with radioiodine (^{131}I) were handled. For the past 10 years, most patients receiving large ($> 1 \text{ GBq}$) therapeutic amounts of ^{131}I for benign or malignant thyroid disease have been released from the control of the treating facility (hospital or outpatient center) since the routine, expensive and unnecessary hospitalization of such patients is no longer required. At the discretion of the treating facility after assessment of the patient's living situation, such treated patients can enter public environs as long as they do not expose an individual family member or a member of the general public to $> 5 \text{ mSv}$. . If it is likely that a member of general public or a pregnant individual or young child is likely to be exposed to $> 1 \text{ mSv}$, than the patient must be provided with verbal and written instructions to keep such radiation exposure as low as reasonable achievable. By adhering to recommendations contained in Regulatory Guide 8.39, this is usually readily accomplished in the home setting by having the patient refrain from close contact with family members, drink fluids liberally, sleep alone for 2 days, and be the sole user of a bathroom for 2 days. Such restrictions have been shown to limit radiation exposure to most children and adult family members to $< 1 \text{ mSv}$. However, we live in a diverse society where it is not always possible for a patient to spend the first 48 hours immediately following ^{131}I therapy in a setting that allows for such restrictions. Some patients travel many hundreds of miles to receive specialized care and cannot readily return to a restricted setting where radiation exposure of others is limited or are at intermediate/high risk for ^{131}I induced complications (i.e. neck pain, nausea and vomiting, airway compromise) that require them to stay in reasonable proximity to the treating facility. NRC regulation and informational guidance give the treating facility considerable latitude in arranging for appropriate housing of such individuals.

Radiation exposure to family members from a treated patient primarily occurs when a family member comes in close prolonged proximity to the patient (so-called external exposure), but it can also occur if the family member inadvertently contacts ¹³¹I excreted by the patient in urine, saliva, or perspiration (internal exposure). Such internal exposure is quite rare and is far below external exposure. In some instances, family members can be readily displaced to homes of other relatives, but this is often not feasible when several young children are involved. Sole use of a bathroom may be an issue that can be circumvented by the patient meticulously cleaning the toilet after each use, but often this is just not practical. The closeness of a family's living circumstances may preclude the patient from returning home or to other relatives or friends home. When faced with such situations, hospitalization or alternative lodging for the ¹³¹I treated patient to prevent excessive radiation exposure to other individuals is required. Hospitalization wastes precious resources and many third party payers do not cover such an expense, so alternative lodging in a rented room of a public facility such as hotel or motel becomes the best option.

Recommended Resources

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5. Siegel JA, Silberstein EB. A closer look at the latest NRC Patient Release Guidance. J Nucl Med 2008;49:17N-20N
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Table 3- Special Instructions for Radioiodine Safety

This information is to help you decrease the amount of radiation that other people might receive from your radioiodine treatment. Radiation can reach other people in two ways:

- 1) From the radioactive rays leaving your body. This type of radiation is strongest for the other person if they are close to your body. If the distance between you and the other person is more than 6 feet, then the radiation reaching the other person is very low.
- 2) From fluids leaving your body. Urine contains the most, but there is some radioactive iodine in other fluids such as saliva, nasal mucus, perspiration, or from bowel movements. If another person touches or swallows these fluids, they can get radioactive iodine into their body.

Both of these types of radiation are the strongest on the first day after treatment and drop off every day after that.

PREGNANCY and BREASTFEEDING

You absolutely cannot receive radioiodine if you are pregnant or breastfeeding because it could harm the baby. If you think that you might be pregnant or if you have been breastfeeding within the last 3-6 weeks, notify your physician or treatment team. You may not pump or restart breastfeeding after your treatment. Women should not become pregnancy for 3-6 months after treatment, depending on the dose of radioiodine, and men should not father a child for 3 months.

SPECIAL SITUATIONS

You may need to follow the safety instructions for a longer amount of time or you may need to make special arrangements, or you may even need to be admitted to the hospital if you have special situations. If any of the following apply to you, please notify your physician or treatment team for special instructions:

- 1) You must use public transportation such as a bus, train, subway or ferry or your car trip will include another person besides yourself and will take more than 8 hours
- 2) You will need to stay in a motel or hotel due to a long trip back home or because you need special follow up after your treatment, such as a scan
- 3) A child under age 10 years old lives with you
- 4) There is a pregnant woman in your household or in your work place
- 5) You are the caregiver for another person and that person is younger than 60 years old
- 6) You are a teacher or day-care worker
- 7) The patient is a child who attends school or day-care
- 8) You leak your urine or bowel movements, or you use a tube or piece of equipment that comes into contact with saliva, your stomach, blood, urine or stool such as a PEG tube or bladder catheter or a tracheotomy tube.
- 9) You become nauseated and vomit easily

USEFUL ITEMS TO PURCHASE IN ADVANCE

- 1) Wipes that can be flushed down the toilet
- 2) Disposable gloves
- 3) Plastic bags for disposable items that cannot be flushed.

ON THE DAY OF TREATMENT

After you receive the radioiodine treatment you should travel to your home or other location by private car, taxi or car service. If you must use a bus, train, subway or ferry then your trip must be less than one hour long and you must follow the special instructions from your radiation team. Most patients will be able to drive by themselves. If not, sit at least 3 feet away from the driver or others in the car and do not allow any more people than necessary to be in the car with you. No children under 11 years old or pregnant women should be in the care with you. If you are driving or riding with others in the car the trip must be less than 8 hours long unless your treatment team has helped you with special arrangements. If you stop for a bathroom break, follow the instructions under "Shared Bathroom" and carry flushable wipes with you to clean the toilet after you use it.

Do not go out in public where you will be close to other people. When you get home or to your destination, stay there. Drink extra liquid (any non-alcoholic beverage is OK) and try to urinate once an hour even if you do not have the urge. Most of the radioiodine that you were given will be passed out through your urine in the first 24 hours. Emptying your bladder often to gets the radiation out of your body as soon as possible and to decreases the amount of radiation that your bladder and pelvic area will receive. Continue to stay well-hydrated for several more days.

HOW LONG TO FOLLOW THESE INSTRUCTIONS

Based on your dose and thyroid condition, this will be filled out by your physician or treatment team.

_____ Days that you need to stay at least 3 feet away from adult household members

_____ Days that you need to stay at least 3 feet away from babies, children younger than 10 years old and pregnant women

_____ Days that you need to stay away from work and close contact with others in public places (movies, shopping, etc)

_____ Days that you need to stay away from school or day-care (both teachers and students)

HOUSEHOLD INSTRUCTIONS

1) PERSONAL CONTACT

- a. Stay at least 3 feet away from everyone at all times and more than 6 feet away most of the time
- b. Sleep in a separate bed at least 9 feet from any other person (including beds in the next rooms)
- c. Avoid kissing and sexual activity

2) BABIES, YOUNG CHILDREN AND PREGNANT WOMEN

- a. Do not care for a baby or a young child for the length of time set by your physician
- b. Stay as far away from pregnant women and all children under 10 years old as you can. The less time that you spend near them the safer it is for them.

3) PERSONAL HYGIENE

- a. If possible use a bathroom that you do not share with others.
- b. Men should sit down while urinating to avoid splashing radioactive urine.
- c. A generous amount of toilet paper should be used to clean well after using the toilet and then flush the paper down the toilet.
- d. Wipe down the toilet seat (top and bottom), and the rim of the bowl at least once daily with disposable wipes that can be flushed down the toilet.
- e. Always wash your hands well after using the toilet.
- f. Use your own towel, face cloth, toothbrush and other personal care items. Do not share.
- g. Take care not to spray saliva when brushing your teeth, rinse the sink out and wash your hands when you are through.
- h. Wipe down the telephone and cell phone mouthpiece after each use with a disposable wipe or damp paper towel and dispose of in plastic bag.
- i. After blowing your nose dispose of the tissues in a plastic bag and wash your hands.
- j. All trash that contains body fluids (including menstrual pads and tissues) should be placed in a plastic bag for disposal and wash your hands.
- k. Be sure to move your bowels daily (to speed up the clearance of radioiodine from your body and decrease the amount of radiation you receive). Use a laxative if necessary.
- l. Shower daily if possible, but especially the first 2 days. Do not urinate in the shower. Rinse the shower or bath well after use.

4) SHARED BATHROOM

- a. Please follow the steps listed in section 3 (personal hygiene) above plus:
- b. Flush toilet and wipe down the toilet seat with flushable wipes after each time you use it.
- c. Rinse sink, shower or tub after each time you use them (use disposable wipes that can be flushed down the toilet).
- d. Separate your toothbrush, towels and other personal grooming items (razors, etc) away from those used by others.

5) KITCHEN

- a. If preparing food for others, wash your hands first and do not taste the food and put the spoon back in the pot. Disposable gloves can be worn for extra safety.
- b. Do not share food and drink with others.
- c. Do not share utensils, such as spoons and forks, or dishes with others. Any item that enters your mouth or could be touched with your saliva should not be shared with others and must be washed prior to re-use. Do not share bottles or cans of soda or other drinks.
- d. It is better to use washable dishes and utensils rather than disposables. Wash dishes in dishwasher or separately by hand and rinse thoroughly. Use of disposable dishes and utensils requires special trash precautions (see below).

6) LAUNDRY

- a. Wash your underwear, pajamas or nightgowns, towels, sheets, and any sweaty clothes separately from other laundry. No need to rinse the washing machine.

7) WASTE, TRASH, DISPOSABLES

- a. Any item contaminated with body fluids which cannot be safely flushed down the toilet should be placed in a plastic bag for disposal.
- b. Menstrual pads, incontinence pads, bandages and wound dressings should be changed often and disposed of in a plastic bag. Wear disposable gloves when handling the items and wash hands when done.
- c. Vomit/blood/stool should be cleaned up carefully with paper towels while wearing disposable gloves and disposed of in a plastic bag. Wash hands when done.
- d. Check with your radiation treatment team regarding when it is okay to put this plastic bag out for trash pick-up. Some landfills and trash facilities have sensitive radiation detectors on-site in which case you have to store this bag someplace for several weeks before you can put it out.

8) PETS

- a. Keep plastic trash bags containing contaminated waste away from pets.
- b. Keep toothbrush and other personal care items away from pets.
- c. Prevent pets from drinking out of toilet (close lid).
- d. Do not sleep with pregnant pets.

OUTSIDE THE HOME

1) CONTACT WITH OTHERS

- a. After the first day you may take a walk or go shopping for essentials, but you should stay at least 3 feet away from other people, except for brief periods of time.
- b. You may not go to social events, movies, concerts, the theater or to a restaurant where you could be closer than 3 feet to another person for more than a few minutes.

2) TRAVEL

- a. You should not use public transportation such as buses, trains, subways or a ferry unless you have special instructions and your trip is short. You may use a taxi, car service or a private car. If using a private car you should drive alone if possible (no car-pooling). If there are other individuals in the vehicle you should sit at least 3 feet away from them and the trip should be necessary.
- b. It is possible that you might set off radiation detectors at national borders, airports, bus or train stations, and your place of employment for 3 months or more following radioiodine treatment. Your treatment team will issue you a letter or card containing information about the therapy along with the phone number for the treating facility in case local law enforcement agents need to check on this information. You should keep this letter or card with you whenever you are traveling for the next 3 months.

3) WORKPLACE

- a. If your job requires close (within 3 feet) contact with other people for long periods of time or contact with children or pregnant women, let your physician or treatment team know so they can give you specific instructions.

4) SCHOOL

- a. School children, teachers and day-care workers should not return to the classroom or other group activities for about one week after radioiodine treatment. Get specific instructions from your physician or treatment team.

5) EMERGENCY CARE

- a. You will receive an information card or letter at the time of your treatment that will show the date, type and amount of radioiodine that you received. Carry this card with you at all times following treatment.
- b. If you are involved in a traffic accident or any other medical emergency within one week of treatment, the medical caregivers should be shown this card to inform them of the date and dose of your ¹³¹I treatment.

6) BLOOD DONATIONS

- a. Do not donate blood for 3 months after your ¹³¹I treatment. You may also not be able to donate bone marrow or other organs for several months after your ¹³¹I treatment, so be sure others are aware of this if the situation comes up.

Table 4- Examples of Days to Sustain Restriction Based on Administered Radiation Activity

Example Precaution Requirements (Days) – Hyperthyroidism

Administered Activity (mCi)	10	15	20	30	60
Sleep in a separate (6 feet separation) bed for	3	6	8	11	17
If your sleeping partner is pregnant or a child shares your bed, sleep separately for	15	18	20	23	29
Do not nap with children or hold an infant or child for more than 30 minutes per day for	12	15	17	20	25
You may return to work after	1	1	2	5	10
Maximize your distance (6 feet) from children and pregnant women for	1	1	2	5	10
Maximize your distance (greater than 3 feet) with other people for	1	1	1	3	8
Avoid extended time in public places for	1	1	1	3	8

Example Precaution Requirements (Days) – Thyroid Cancer Post Surgical Remnant
(5% long-term fraction)

Administered Activity (mCi)	75	100	150	200	300	400	500
Sleep in a separate (6 feet separation) bed for	1	3	7	10	14	17	20
If your sleeping partner is pregnant or a child shares your bed, sleep separately for	17	20	24	27	31	34	37
Do not nap with children or hold an infant or child for more than 30 minutes per day for	12	15	19	22	26	30	32
You may return to work after	1	1	1	2	5	8	11
Maximize your distance (6 feet) from children and pregnant women for	1	1	1	2	5	8	11
Maximize your distance (greater than 3 feet) with other people for	1	1	1	1	2	5	8
Avoid extended time in public places for	1	1	1	1	2	5	8

Table 5-Sample Information Card for Patient Receiving Radioiodine

Example Information Card [40]

Nuclear Medicine Patient Information Card:
Security personnel and law enforcement Notification

(Patient Name) has undergone a nuclear medicine procedure on *(Date)* at *(Facility Name)* involving a small quantity of short-lived radioactive materials.

The residual radioactivity may be detectable externally until: *(Month)(Date)(Year)*.

The radiation received by the patient poses no danger to the public and is allowed by medical use regulations.

If there are any questions, please contact (24 hr. *Contact Name*) at *(Contact Phone)*.

Table 6-Actions to Maintain Doses to Others ALARA (As Low As Reasonable Achievable) Post ¹³¹I Therapy

Follow these instructions for the length of time as specifically determined by your treating institution:

Travel

- Avoid public transportation if possible. If necessary, travel by public transportation should be restricted to about 2 hr. Private transportation with relatives or caregivers should be restricted to about 6 hr. Try to sit at least 3 ft (1 m) from others.

Contacts at Home

- Avoid prolonged physical contact. Stay at least 3 ft (1 m) or more from everyone at home at all times and more than 6 ft (2 m) for extended periods of time. Do not remain within 3 ft (1 m) of any individual for more than 6 h per day.
- Avoid kissing, intimate contact, or sexual intercourse.

Bedroom

- Sleep in a separate bed and in a separate bedroom if possible.

Bathroom

- Have the sole use of a bathroom, if possible. Patients (including men) should sit down while urinating. Toilet paper should be used to dry the genitals and should then be flushed down the toilet. It is not required to flush the toilet more than once.
- Use a separate towel, face cloth, and toothbrush from the rest of the family. Take care not to spray saliva when brushing teeth and rinse out the sink when you are through.
- Shower daily if possible but especially for the first 2 days. Do not urinate in the shower. Rinse the shower or bath well after use.
- Be sure to move your bowels daily. Use a laxative if necessary.
- For trash that contains body fluids (including menstruation pads and nasal tissues) use a plastic bag to dispose.
- Always wash hands well after using the bathroom.

Kitchen

- Drink plenty of fluids (about 1 glass per hour) on the day of your treatment and continue to be well hydrated for several days following treatment.
- Do not share food or drinks with others. Some recommend using disposable dishes and utensils but this is not necessary and may cause difficulties at landfills that have installed radiation monitors. Therefore, it is acceptable to simply wash dishes and eating utensils well and re-use them. If available, a dishwasher is adequate.
- There are no restrictions for handling of food for others. Remember to wash your hands first and do not taste the food and put the spoon back in the pot.
- Wipe down the telephone or cellphone mouthpiece several times daily with a handi-wipe or wet paper towel.

Laundry

- Wash your underwear, bedclothes, towels, sheets, and any sweaty clothing separately from other laundry. No need to rinse the washing machine.

Babies, Children, and Pregnant Women

- If you have a baby, it is best for someone else to care for the baby. If this is not possible, do not have the baby too close to you (sleeping, sitting on your lap for more than a very short time, less than 30 minutes per day).
- Visits by children and pregnant women should be discouraged. If necessary, minimize contact and maximize distance from children and pregnant women.
- It is important to avoid kissing your infant or child as this can transfer radioiodine and result in an unnecessary risk to your child.

Breastfeeding

- Do not breastfeed your baby after radioiodine therapy. If you have been breastfeeding your baby, you must stop before radioiodine therapy. It may be beneficial for you to discontinue breastfeeding 2-3 weeks before radioiodine therapy to reduce dose to the breast tissue during treatment.

Elderly Partners

- For family members and carers aged 60 years old or more, the risk of radiation detriment is small; therefore, only those measures that are easy to comply with are encouraged for these cases.

Social Events

- Visits to the cinema or other social events where you may be in close contact (i.e., within 3-6 feet) with other individuals for several hours should be avoided.

Returning to Work

- Most patients should not return to work for at least 2 days after treatment (this time may be decreased or increased depending on the specific requirements as determined by the treating facility). However, if your job requires close contact with other people for long periods of time, notify your physician to enable an evaluation of how long you will need to be absent from work.

Emergencies

- If you are involved in a traffic accident or other medical emergency, the medical caregivers should be informed of the date, type, and amount of radionuclide therapy you received.

Pregnancy

- If you think that you are pregnant and did not know it at the time you received radioiodine, inform your physician immediately. Discuss with your physician how long you should wait before becoming pregnant after radioiodine treatment. Typically, pregnancy should be avoided for 6-12 months (females) or 3 months (males), or until thyroid hormone status has been verified by your physician to be under control.

Homeland Security and Landfill Detectors

- It is likely that you might alarm radiation detectors at national borders, airports, within cities, or your place of employment for 95 days or more following radioiodine treatment. Your treating facility will issue you a letter or card containing appropriate information about the therapy along with a phone number for the treating facility in case local law enforcement agents need to verify this information. You should keep this letter or card with you whenever you are traveling.

- It is also possible that radioactive articles in the household trash of nuclear medicine patients could alarm radiation detectors at solid waste landfills.